IAF SPACE PROPULSION SYMPOSIUM (C4)
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DEVELOPMENT OF AN ADDITIVELY MANUFACTURED HYDROGEN PEROXIDE / KEROSENE 6 KN AEROSPIKE BREADBOARD ENGINE

Abstract

Within the framework of the ESA funded ASPIRER project, an additively manufactured aerospike breadboard engine using kerosene and hydrogen peroxide as propellants is developed and tested. This contribution summarizes the design and test planning activities carried out during the project. In this regard, the overall system design is discussed in detail. The engine is designed for 6 kN thrust at 2.0 MPa chamber pressure and is manufactured from nickel-base superalloy INCONEL®718 powder using the laser powder bed fusion process. A staged-bipropellant concept is applied, where hydrogen peroxide is decomposed by a catalyst and combustion is initiated by kerosene autoignition. The configuration of the catalyst housing is presented, which is designed as a replaceable subassembly and consists of a showerhead injector, main housing and distributor plate to be able to test multiple catalyst compositions during the hot-fire tests. The kerosene injector uses the transverse jet penetration concept by injecting propellant orthogonal to the hydrogen peroxide oxidizer flow. The two major engine components aerospike and shroud are additively manufactured and directly include the cooling channels used for a water dump cooling system. The contribution outlines crucial design components for manufacturing and functionality. Major focus of the project is placed on determining the thermal loads during the subsequent testing, as it

is one of the major unknowns left for aerospike rocket engines. Therefore, the developed test plan specifies the thermal measurements necessary to determine the shroud wall temperature. During the design process, critical design features for manufacturing were identified and test manufactured together with the project partner Fraunhofer IWS. The outcome of the thereby created iterative design process to optimize the structure for additive manufacturing is shown in detail. The project is part of the overall effort at TU Dresden to overcome the low Technology readiness level (TRL) and the following uncertainties associated with aerospike rocket engines and is carried out in cooperation with Fraunhofer IWS, the Lukasiewicz Institute of Aviation and ArianeGroup.